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DEPARTMENT OF FISH AND GAME
Marine Region

Final
CRUISE REPORT: 04-S-1

Exploration and Inventory of Santa Barbara Channel Islands Marine Protected Areas – A Cooperative Remote Operated Vehicle Study with the Department of Fish and Game, Channel Islands National Marine Sanctuary, and Marine Applied Research and Exploration

by

Konstantin Karpov, Mary Bergen, Dirk Rosen, Andrew Lauermann, Mike Prall, and Christine Pattison

California Department of Fish and Game

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Vessel: The NOAA *R/V Shearwater*

Dates: Leg 1: November 11-14 and 19-25, 2003
Leg 2: May 13-18, 2004
Locality: Three of the Northern Channel Islands off the Southern California Bight (Santa Rosa, Santa Cruz, and Anacapa Islands).

ABSTRACT

Research cruises in November 2003 and May 2004 included cooperative training in remotely operated vehicle (ROV) and boat operations, refinements in ROV survey methods, and exploratory surveys of sites that will be used to evaluate the effects of recently-established Marine Protected Areas (MPAs) in the northern Channel Islands. With training, we developed consistency in ROV tracking and in post-processing of data as well as the ability to interchange crew members. We also increased the efficiency of ROV operations. Checklists were generated for each of the key team members. We sampled 14 sites at three of four targeted MPA's and adjacent reference sites. We completed 39.5 km of ROV track line, producing 26.4 hours of high-quality video. The video tapes have been reproduced on DVD for archival storage and ease of access for future analysis.

Introduction

Recent efforts to develop new strategies to help protect and recover California's declining ocean resources have led to considering new methods including extensive marine protected areas (MPAs) as a possible management tool (CDFG 2003 and CDFG 2004). One of the first tests of these concepts is a network of Marine Protected Areas (MPAs) in the northern Channel Islands in southern California that include eight State Marine Reserves (SMRs) where all take is prohibited (Figure 1).

Recognizing the need to develop a monitoring plan to assess the effect of these MPAs, DFG, the Channel Islands National Marine Sanctuary (CINMS) and National Oceanic Atmospheric Administration (NOAA) convened the Channel Islands MPA monitoring workshop in March 2003 (CDFG 2004). One of the priorities identified in the resulting Monitoring Plan was collection of baseline monitoring data in sites within and adjacent to the MPAs. The objective was to compare changes in abundance of species of concern in the MPA's to nearby fished "reference sites".

DFG identified a number of priority areas to be surveyed most of which have been mapped acoustically (John Ugoretz Personal Communication - Table 1). The United States Geological Survey (USGS) and California State University of Monterey Bay Seafloor Mapping Lab (CSUMB) have completed high-resolution acoustic maps in many of these areas (Guy Cochran unpublished, Rikk Kviteck unpublished). Sites off northern San Miguel Island were only recently surveyed by USGS and are in the process of being prepared for use (Guy Cochran unpublished).

The monitoring workshop proposed using visual survey methods for the monitoring, using divers in less than 20 m and ROVs and submersibles in deeper water. Recent advances in ROV technology and methods have produced monitoring protocols that are similar to SCUBA protocols with the advantage of producing archival video records with associated DGPS location that can be used for future comparisons (Veisze and Karpov 2002). SCUBA is known as an effective tool for monitoring abundance changes of finfish and invertebrates of management concern inside kelp areas where ROVs and submersibles cannot operate (Berry and Baxter 1993, Larson and DeMartini 1984, and Miller and Geibel 1973). Outside of the kelp canopy, ROVs and submersibles have the advantage of being able to survey much larger areas without the concern of time at depth that limits SCUBA surveys (Barry and Baxter 1993).

In order to conduct the ROV surveys, a partnership between the DFG, Marine Applied Research and Exploration (MARE), and CINMS was formed to combine

Table 1. Sites identified by DFG for monitoring, listed in order of priority and acoustic mapping status.

Priority	Site Name	Location	Mapping Status
1a	West Anacapa Island	Anacapa Isl.	USGS sidescan out to 100m multibeam deeper
1a	East Anacapa Island	Anacapa Isl.	USGS sidescan out to 100 m multibeam deeper
1b	Carrington Point SMR	Santa Rosa Isl.	CSUMB multibeam
1b	Rodes Reef- reference site	Santa Rosa Isl.	CSUMB multibeam
2a	South Point SMR	Santa Rosa Isl.	CSUMB multibeam
2a	W. of South Point (Cluster to Bee Rk.)*- ref site	Santa Rosa Isl.	CSUMB? multi beam
2b	Harris Point SMR	San Miguel Isl.	USGS Sidescan out to 100m, shallower than 20m not done
2b	Wilson Rock- reference site	San Miguel Isl.	USGS sidescan
3a	Gull Island SMR	Santa Cruz Isl.	CSUMB multibeam
3a	East Point- reference site	Santa Rosa Isl.	
3b	Foot print- between Anacapa Isl. & Santa Cruz Isl., pinnacles right on state waters' border (not paired)	Anacapa Isl.	USGS multibeam from 100 to 800 meters depth
3b	Scorpion SMR (little hard bottom)	Santa Cruz Isl.	USGS sidescan out to 100m, USGS or MBARI multibeam deeper
4	Richardson Rock SMR (difficult to work)	San Miguel Isl.	
5	Judith Rock & Miracle Mile	San Miguel Isl.	USGS sidescan out to 100 m
6	Santa Barbara SMR & Outside	Santa Barbara Isl.	CSUMB? multi beam

available resources. DFG provided the core ROV research team; MARE added technical assistance and the ability to garner additional fiscal support; and CINMS provided their 19 m catamaran, the *RV Shearwater*, as a research platform.

The goal of the partnership was to collect data that could be used to evaluate the effect of the newly-created State Marine Reserves (SMRs) on the abundance of finfish of management concern in hard bottom habitats in water depths between 20 to 80 m. Initially, the goal was to collect archival video that could be used as base line data and conduct exploratory surveys to locate study sites and to test final survey protocols. The ultimate goal was to conduct quantitative surveys that could be used to statistically evaluate changes in finfish abundance over time.

To meet these goals, we secured funding, planned and executed three research cruises. The first two cruises, completed in November 2003 and May 2004, included cooperative training in ROV and boat operations, refinements in ROV survey methods, and exploratory surveys. The objectives of the exploratory surveys were to: 1) visually verify habitats types as aids to using acoustic maps in selecting the best sites for quantitative surveys; 2) collect archival video with its associated DGPS position for finfish and invertebrates; and 3) count a subset of managed finfish for a preliminary evaluation of the range of abundances that might be encountered during a survey. The objective of the third cruise in September 2004 was to implement quantitative methods at two sites explored in the previous two surveys to begin testing the first priority question of MPA effectiveness in stock recovery; that is, to measure change in abundance. A report describing the field portion of the September survey has been completed by Karpov et al (2004), with a final report evaluating the results of the quantitative survey planned for the spring of 2005.

The purpose of this report is to describe the methods and results of our November 2003 and May 2004 exploratory surveys. Here we describe the results of the training, the extent of surveys we completed, the habitats we encountered, and suggest protocols for future exploratory and quantitative surveys.

Methods

Study Site and Track Line Selection

In November 2003 and May 2004, exploratory ROV surveys of reserve and reference sites were targeted at four of the northern Channel Islands: San Miguel, Santa Rosa, Santa Cruz, and Anacapa Islands (Figure 2). Based on expected topography from available acoustic maps (USGS and CUSUMB unpublished), we selected five State Marine Reserves, including Harris Point SMR, Carrington Point SMR, South Point SMR, Gull Island SMR, and Anacapa Island SMR on the four islands.

Study sites for exploratory surveys were selected by reviewing poster size enlargements of acoustic survey maps with shaded topography that appeared to contain rocky habitat. We selected potential site pairs, one in a SMR and one in nearby fished habitat to serve as a reference area. We selected sites with comparable habitat and depths, and, where possible, offshore of the Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) study sites being surveyed by SCUBA divers (Figure 2). In general, sites were planned to be at least 500 m wide and to span a depth range of 20 to 80 m. In practice, the depth range was limited by the depth span of the SMR and extent of apparently hard habitat in the acoustic images.

With an ROV it is more efficient to use long transect lines relative to divers who can deploy short randomly-placed transects (Barry and Baxter 1993). For this reason, we developed a systematic random approach where we video a long track line and then randomly choose segments of the line for transects. At most sites, we used a zigzag pattern of straight lines (Figures 3 to 30). The zigzag pattern was designed to gradually move up slope, minimizing down-slope segments that are difficult to capture on forward video, while efficiently using dive time to sample a wide depth range. In steep-sloped or areas with narrow hard substrate, we used straight lines parallel to the depth contours rather than the zigzag pattern (Figure 3). Both the zigzag and parallel approach produce useable legs minimally 500 m in length. Stops for onboard sonar image capture were planned at the ends of these lines.

Operations

ROV operations were conducted off the *RV Shearwater,* a 19 m catamaran owned and operated by NOAA's Channel Islands National Marine Sanctuary (CINMS) program.

Training and system integration was planned for Nov 11 through the 14, the first week of the November survey. Our training consisted of integrating four separate teams (six ROV staff) in addition to the *RV Shearwater* captain and crew into a cohesive operational unit. The teams included a deck officer and assistant, a finfish taxonomist and data recorder, navigator and pilot, and vessel captains. The taxonomist data recorder worked next to the pilot and navigator, but independently at their own monitor and computer data station, while the other three teams were in constant communication by VHS radio. Key physical metadata needed for post-processing was communicated to the data recorder by the navigator. In addition, the navigator provided the ROV pilot with headings, VHS communication, metadata (video story board and digital records), and video recording needed to ensure quality archival video. The pilot maintained the ROV at the constant heading; target distance and width of the camera view, altitude, camera angle, and velocity needed to ensure quality virtual transect line. The deck officer directed launch and recovery of the ROV and tracking system, communicated with the bridge and navigator, while working with the assistant to adjust and record clump weight depths. The assistant ran the winch and the crane and assisted in umbilical operations and tracking system deployment.

Part of our training operation included developing printed protocols and checklists to insure critical operations were completed by our trainees without risking the operations (Appendix 1). While training was continuous, exploratory surveys were planned to begin at the end of the first week and to continue from November 19 to 29 and from May 13 to 18.

To test vessel operation, tracking and piloting skills acquired during both November and May, on the last day of field survey (May 17) we used all trained staff to replicate four track lines at the same site off Anacapa Island (AI 1). We conducted two consecutive dives, spanning five hours. To test consistency of operations, we switched among the four pilots and two vessel captains during and between each of the two dives. Post processing of habitat for both dives was also completed independently to examine consistency of spatial tracking and habitat classification by the postprocessors. Processing was completed independently by one of the co-authors and three staff trained by him to identify habitat types.

At each site, the ROV was flown along the pre-planned track targeting ± 10 m of the center line. The forward camera recorded the water column approximately 2 m in front of the ROV and a downward-facing camera recorded the substrate, sessile algae, and invertebrates. GPS time was recorded on each video frame ($1/30^{th}$ sec) and on an audio track using methods developed by Veisze and Karpov (2002). ROV sensor data for water depth, temperature, ROV heading, ranging sonar, and camera tilt angle were also recorded.

The ROV was flown to maintain an average height 0.5 m above the bottom, a targeted velocity of less than 1.0 m-per-second, using a 15 to 30 degree camera tilt angle. A thruster auto-trim helped the pilot maintain a constant velocity. Velocity was increased across long areas of pure sand.

At the end of each leg of the line, the ROV was landed for 10 or more seconds to capture an image with on-board Imagenex 855 ® scanning sonar that provides a clear color image of the surrounding elevated topography. These images were archived for comparison to mapped locations for future meta-analysis of spatial precision.

The ROV was flown off the vessel stern using a “live boat” technique that employed a 110 kg (220 lb) clump weight. With this method all but 40 m of the ROV umbilicus is secure from current-induced drag by being attached to the clump weight cable which is suspended at least 5 m off the bottom. The 40 m tether allowed the ROV pilot to maintain a straight course parallel to the ship without being pulled using the location of the ship, the ROV, and the track line that are displayed on shipboard monitors. Three herring floats were affixed to the 40 m of tether to help avoid snagging the umbilical in high relief areas.

Track line width on the forward camera was determined from a ranging sonar fixed below and parallel to the camera between the two forward-facing red lasers spaced 110 mm apart. To achieve a transect width between 2 and 4 m, the pilot used the ranging sonar to maintain the distance from the camera to the substrate (at the screen horizontal mid point) between 1.5 to 3 m. Based on the camera field of view, transect width is computed as 1.3 times the ranging sonar distance.

In addition to the forward lasers, two pairs of downward facing lasers produce beams spaced 130 and 750 mm apart. During previous ROV research cruises, these lasers provided the only data we could use to estimate transect width. For this cruise we used the lasers to evaluate the new ranging sonar methodology.

Prior to the start of the cruise and at the end of the cruise, the ranging sonar and compass on the ROV were calibrated while other calibrations such as the distance between paired laser beams and depth were checked before launch and after retrieval.

Counts of a selected subset of adult finfish including lingcod (*Ophiodon elongatus*), sheephead (*Semicossyphus pulcher*), ocean whitefish (*Caulolatilus princeps*), and rockfish (*Sebastes spp.*) were made in “real time”. The taxonomist counted the fish over the substrate when they reached a position at mid screen in the monitor, typically this would only include fish ≤ 1m over the bottom. Fish smaller then 110 mm (predominantly young of the year rockfish) were excluded from the counts. The forward paired laser was used as a reference to estimate the size of the fish. The data recorder entered the counts in the one second file (Veisze and Karpov 2002) using a keypad preprogrammed with species names.

After the survey, data was post processed. Positional information in the form of XY metric coordinates was filtered for outliers and smoothed using a 21 point running mean (Whittaker and Robinson 1967). The distance formula was used to calculate planer tracked distance per second that was then combined with width to calculate tracked area per second.

The video record was reviewed for habitat that was classified independently as rock, sand, or boulder. Substrates classification was simplified from Green et al (1999). Rock was defined as any igneous, metamorphic, or sedimentary substrate; boulders as rounded rock material that is between 0.25 and 3.0 m in diameter and clearly detached from the base substrate; and sand as any granular material with a diameter less than 6 cm (may include mud, organic debris such as shell or bone, gravel, or pebble). Cobble (6 to 25 cm was not included in our analysis. Each of the substrate types were recorded as discrete segments with a beginning and ending GPS time code. During the viewing, a substrate layer was considered continuous until a break of 2 m or greater occurred. Following processing to determine the proportion of sand only substrate, the three habitat types were combined as either purely rock, mixed (rock or boulder and sand), or sand only.

The rock only, mixed, and pure sand categories added to 100 percent. Since boulder was seldom found alone but invariably occurred either over rock, sand, or both the habitat was classified “with” boulder as a separate percentage.

Results

Training added three pilots, a navigator, a deck officer, a taxonomist and two boat captains to the list of personnel qualified to participate in ROV live boating methods. Checklists were generated for each of the key team member roles, including ROV pilot, navigator, and deck officer (Appendix 1).

During November 2003 and May 2004, 14 sites were sampled at three of four targeted State Marine Reserves (SMR) and adjacent reference sites (Figure 2, Appendix 2). We sampled three SMRs: Carrington Point, South Point, and Anacapa Island. Carrington Point SMR included two sites (SRI 1 and 2). Rodes Reef (SRI 3), four km to the west (Figure 2), is a potential reference site for SRI 1 and 2. Five sites were sampled in association with Gull Island SMR, including two sites in the reserve (SCI 1 and 2); two sites to the south-west on Santa Cruz Island (Bowen Point SCI 3 and south-central SCI 4); and a third potential reference site on south-east Santa Rosa Island (SRI 6).

During both November and May, adverse weather precluded sampling sites off Harris Point SMR on San Miguel Island and limited sampling associated with South Point SMR, Santa Rosa Island, to two small sites, one in the reserve (SRI 4) and the other off Cluster Point (SRI 5), west of South Point SMR (Figure 2). Hard bottom habitat at both these sites was limited in depth range and there was inshore kelp that risked entangling the ROV. The South Point SMR (SRI 5) line 2 was aborted due to extreme tidal currents that placed the ROV at risk. The ROV velocity at this site ranged from 0.2 m to 0.8 m per sec, the widest range encountered, as the ROV flew against and with the current (Appendix 3).

During the 17 days of cruise time in November and May, we completed 39.5 km of ROV track line, producing 26.4 hours of high quality ROV tracking video. Eight of the 17 days were required for non-sampling activities, including set up and system calibrations (3 days), training (2), adverse weather (1), and demobilization (2). During the nine remaining days of actual field sampling, we averaged 4.4 km of track line per day. The average distance sampled per field day increased from 3.7 in November to 5.2 during May (Table 2). Archival high density digital video tapes have been reproduced and stored at two CDFG sites.

On the last sampling day of the May cruise (May 17) we succeeded in repeating three of four tracked lines off the north west Anacapa Island site AI 1 (Table 2, Figures 3 and 4). Just ten minutes (20:08 GMT) into the fourth line of our second dive the ROV compass failed, forcing us to abort before completing the last line of the second dive (Appendix 3). The three replicated lines provide additional data to evaluate our piloting.

Table 2. Site codes times with ROV track length, average velocity, depth, and distance tracked per day in November 2003 and May 2004 compared to the September 2004 survey.

				ROV	Track Average			
Site	Date	Start Time (GMT)	End	Velocity (m / sec.)	Depth (m)	Width (m)	Length (km)	km / Day
SRI 1	11/14/03	16:00	17:59	0.4	36.3	2.6	2.4	
SRI 3	11/14/03	19:00	20:25	0.5	31.3	3.0	2.3	4.6
SCI 1	11/20/03	23:10	18:43	0.5	48.4	2.9	4.3	
SCI 2	11/20/03	18:01	22:02	0.4	51.2	3.9	4.3	8.7
SCI 3	11/21/03	20:28	21:17	0.8	29.9	3.7	1.7	
SRI 4	11/23/03	0:15	0:35	0.5	26.9	6.1	0.6	
SRI 5	11/23/03	22:37	23:28	0.5	25.1	4.3	0.8	1.4
SRI 2	11/24/03	15:40	16:48	0.6	29.1	3.5	2.1	
AI 2	5/14/04	19:57	21:52	0.4	29.3	2.9	2.9	
AI 3	5/14/04	22:33	18:00	0.4	41.5	3.0	2.8	5.7
AI 4	5/15/04	14:58	16:58	0.5	42.5	3.1	2.7	
SRI 6	5/15/04	20:22	22:39	0.5	28.9	3.4	3.9	6.6
SCI 4	5/16/04	18:27	19:57	0.5	37.9	2.9	2.8	
AI 1(a)	5/17/04	15:13	17:26	0.5	36.8	3.3	3.1	
AI 1(b)*	5/17/04	17:59	20:09	0.5	38.6	3.3	2.8	5.9
	Nov. 2003			0.5	34.8	3.7	18.5	3.7
	May 2004			0.5	36.5	3.2	21.0	5.2
	Combined			0.5	34.5	3.4	39.5	4.4
	Sept. 2004						57	6.3

* Does not include all four lines as in dive AI 1(a). Line four was only partially completed on dive (b) at site AI 1.

Average velocity, depth, transect width and length for the three lines was similar for the two dives (Table 3). The linearity of tracking is visually apparent over the three repeated lines in reference to the ± 10 m planned track boundary (Figure 3). On three occasions the ROV was pulled off bottom (purple lines) with two of these on line 2 during the first dive, resulting in severe deviation from the planned track.
A line by line comparison showed that track velocity was almost double on line 2 compared to both lines 1 and 3 that were run against a current.

Table 3. Comparison of tracking parameters for replicated lines off Anacapa Island Anacapa Island on May 17.

Site	Line	Dive	Date	Begin. Time (GMT)	Ending	Velocity (m/s)	Depth (m)	Width (m)	Length (m)
AI 1A	1A	241	5/17	15:13	15:55	0.3	47.8	3.2	876
	2A			16:04	16:25	0.7	41.2	3.2	863
	3A			16:29	17:01	0.4	35.3	3.3	780
	1A-3A			15:13	17:01	0.5	41.4	3.2	2,519
AI 1B	1B	242	5/17	17:59	18:38	0.3	47.2	3.1	825
	2B			18:43	19:02	0.7	43.3	3.8	816
	3B			19:17	19:51	0.4	35.4	3.1	797
	1B-3B			17:59	19:51	0.5	41.9	3.3	2,438

The relative proportion of four habitat types averaged over the three lines was almost identical, deviating less than 1 percent (Table 4). Similar habitat types were found at essentially the same locations (Figure 3a and b). Approximately the same number and species of fish species were seen on the lines, although there were more rockfish in the first than on the second pass of line 1 (52 vs. 12 fish).
The habitat types at the sites we sampled are shown in Table 5. At Anacapa Island, sites ranged from 49 to 74 percent sand only. The relative amount of rock only was greatest on the Anacapa Island SMR site AI 2 with18 percent. Only one Anacapa site (AI 4) had a large boulder field.

On south Santa Cruz Island, sand only habitat ranged from 67 percent at Bowen Point (SCI 3) to 87 percent at Gull Island SMR (SCI 1). Rock only was less than 10% and Bowen Pt did not have rock only habitat.

The six sites off Santa Rosa Island varied considerably by proportion of habitat. Sand only habitat ranged from ten percent at SRI 2 to 72 percent at SRI 6. Three sites had 36 to 47% rock only habitat, while three sites had less than 6% rock only habitat. South-east Santa Rosa Island (SRI 6) was lacking rock only habitat. At Carrington Point SMR (SRI 2) boulders were observed over rock only habitat (Figure 21, Table 5).

Table 4. Comparison of habitat and number of fish between replicated lines off Anacapa Island on May 17.

Site	Line	Rock only	Mixed	Sand only	w/ Boulder	Ling	Ocn. Whtfsh.	Sheep-head	rock-fish
AI 1A	1A	10.9%	22.2%	66.8%	0.0%	1	2	3	52
	2A	0.3%	10.7%	89.0%	4.8%				2
	3A	2.6%	32.2%	65.3%	0.0%	1		1	5
	1A-3A	4.6%	21.7%	73.7%	1.6%	2	2	4	59
AI 1B	1B	7.5%	28.2%	64.3%	0.0%	1	2	2	12
	2B	0.0%	11.4%	88.6%	4.7%	4			3
	3B	7.7%	25.4%	67.0%	0.5%	1		2	4
	1B-3B	5.1%	21.7%	73.3%	1.7%	6	2	4	19

Table 5. Percentage of rock only, mixed, sand only and with boulder at the sites sampled on Anacapa, Santa Cruz and Santa Rosa Islands

Site Description	Site Code	Percentage Rock only	Mixed	Sand only	With Boulder
Anacapa Island (AI)					
north - west AI	AI 1(a)	10	32	59	2
	AI 1(b)*	14	20	66	1
AI SMR	AI 2	18	33	49	2
AI SMR	AI 3	10	40	50	5
south east AI	AI 4	10	28	62	14
Santa Cruz Island (SCI)					
Gull Is. SMR	SCI 1	5	8	87	0
Gull Isl. SMR	SCI 2	8	28	64	0
Bowen Pt.	SCI 3	0	34	67	0
s. central SCI	SCI 4	6	19	75	0
Santa Rosa Island (SRI)					
Car. Pt. SMR	SRI 1	4	54	42	0
Car. Pt. SMR	SRI 2	36	55	10	12
Rodes Reef SRI	SRI 3	6	54	41	1
South Pt. SMR	SRI 4	42	27	31	0
Cluster Pt. SRI	SRI 5	47	41	13	2
s. east SRI	SRI 6	0	28	72	0
	All	13	32	55	3

* Does not include all four lines as in dive AI 1(a). Line four was only partially completed on dive (b) at site AI 1.

Discussion

The increase between November and May in the amount of transect sampled (Table 2) indicates that training was successful. In addition, when we repeated sampling of lines on Anacapa Island, ROV velocity and other sampling parameters as well as the amount and location of habitats were consistent, indicating that tracking and post processing were consistent. By the end of the cruise, the crew were working as a team and, with cross training, we were able to use people interchangeably.

The zigzag exploratory survey pattern was useful in sampling large areas that had been previously mapped acoustically but is, perhaps, poorly suited to determine the relative proportion of habitat types. Two factors contributed to this problem, including the patchy distribution of hard substrates among predominantly sanded areas and lack of spatial accuracy of side-scan acoustic maps. At almost all of our sites we observed either small or large islands of rocky areas surrounded by sand only habitat. When we used side-scan maps with potential errors of 20 or more meters and a widely-spaced zigzag pattern, we were likely to miss hard-bottom patches. Multi-beam maps with spatial accuracy of ± 5 m will provide better data. In addition, in future quantitative abundance surveys we will use more intensive sampling covering 12 km of transect per site where lines are distributed randomly parallel to the depth contour (Karpov et al 2004). Such survey will provide a more precise estimate of actual habitat at a sampled site.

The data from this cruise has already been useful. Preliminary results were used to select primary and secondary sites for quantitative sampling in September 2004 (Karpov et al. 2004). Acoustic mapping and the proportion of hard or mixed substrate were used to determine the location and amount of habitat needed to provide sufficient samples to statistically detect changes in finfish populations.

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Personnel
November 11-14 and 19-24, 2003
May 12-18, 2004

R/V Shearwater Personnel:

Lumann Moody	Captain - NOAA
Terrence Shinn	Captain - NOAA

ROV Team Personnel:

Konstantin Karpov	Senior Biologist – CDFG and Principal Investigator
Dirk Rosen	Director - Marine Applied Research and Exploration (MARE) and Vice President, Special Projects - Deep Ocean Engineering
Michael Prall	Biologist (Marine/Fisheries) - CDFG
Christine Pattison	Associate Biologist (Marine/Fisheries) - CDFG
Andy Lauermann	Biologist - Marine Applied Research and Exploration Volunteer - CDFG
Steve Holz	Biologist - Marine Applied Research and Exploration Volunteer - CDFG

Other Participants:

Eric Larson	Northern California Manager/ Bays and Estuaries Ecosystem Coordinator - CDFG
Kristine Barsky	Senior Specialist - CDFG
Sarah Fangman	Channel Islands National Marine Sanctuary, NOAA
Emma Hickerson	Flower Gardens National Marine Sanctuary, NOAA
David Jeffery	Deep Ocean Engineering
Shane Anderson	University of Santa Barbara
Eric Hessell	University of Santa Barbara
Dan Adams	Santa Barbara City College
Dan Howard	Cordell Bank National Marine Sanctuary
Michael Carver	Cordell Bank National Marine Sanctuary

Guests:

Dr. Mary Bergen	Senior Environmental Specialist IV – CDFG; Nearshore Fishes Research Mandate Coordinator
Mike Chrisman	Secretary, California Resources Agency
John Ugoretz	Senior Biologist - CDFG
Anne Canwright	Freelance writer
Chuck Cook	The Nature Conservancy
Debbie Drake	The Nature Conservancy
Lotus Veremer	The Nature Conservancy

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